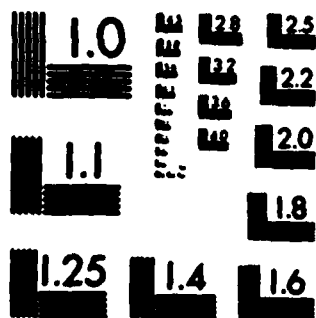


NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
MERINO POND DAM (MA 0. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV SEP 79

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NATIONAL BUREAU OF STANDARDS 1963-A

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THAMES RIVER BASIN
DUDLEY, MASSACHUSETTS



MERINO POND DAM
MA 00110

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

SEPTEMBER 1979

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Thames River Basin Dudley, Massachusetts		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) > Merino Pond Dam is approximately 285 feet long and has a maximum height of approximately 19.5 feet. It consists of an earth embankment with stone walls at the upstream and downstream faces and a loamed and seeded crest. Based on the size classification, small, and hazard potential, high, the selected spillway test flood was the $\frac{1}{2}$ PMF. 7		



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEED

JAN 10 1980

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Inclosed is a copy of the Marino Pond Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, Mr. Robert Javery, Plant Engineer, Stevens Associates, Box 220, Webster, Massachusetts 01570.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely,

Max B. Scheider
MAX B. SCHEIDER

Colonel, Corps of Engineers
Division Engineer

Incl
As stated

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MERINO POND DAM
MA 00110

THAMES RIVER BASIN
DUDLEY, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

Identification: MA 00110
Name of Dam: MERINO POND DAM
Town: DUDLEY
County and State: WORCESTER COUNTY, MA
Stream: TRIBUTARY OF FRENCH RIVER
Date of Inspection: 13 AUGUST 1979

BRIEF ASSESSMENT

Merino Pond Dam is approximately 285 feet long and has a maximum height of approximately 19.5 feet. It consists of an earth embankment with stone walls at the upstream and downstream faces and a loamed and seeded crest. A swale to the north of the left abutment currently serves as an emergency overflow.

The facility is considered in poor condition. This classification is based on observed seepage in the area of the spillway and the left embankment, and apparent lateral movement of the left downstream masonry wall.

Based on the size classification, small, and hazard potential classification, high, in accordance with Corps of Engineers Guidelines, the selected spillway test flood was the 1/2 Probable Maximum Flood. Hydrologic analysis indicates that the spillway capacity with the water surface at the top of the dam is approximately 1,050 cfs, while the emergency overflow has a capacity under the same conditions of approximately 250 cfs. The total discharge capability with the water surface at the top of the dam is about 65 percent of the routed test flood outflow of 2,000 cfs. The estimated test flood stage is about 0.8 feet above the nominal top of the dam.

Investigations are recommended to determine the stability of the embankment, the effect of seepage, the method of dewatering the reservoir when necessary and the need and means of increasing the discharge capabilities at the facility. Recommended remedial measures include the cutting of vegetation, the reshaping of the dam crest, the repair of walls and spillway apron and the performing of maintenance work on the bridge over the spillway. The Owner should develop a formal maintenance program, operational procedure, and emergency procedures plan and should institute a program of annual technical inspections. The remedial measures and recommendations should be performed within one year of receipt of this report by the Owner.

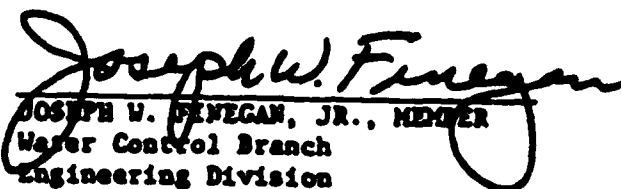
CAMP DRESSER & MCKEE INC.


Roger H. Wood

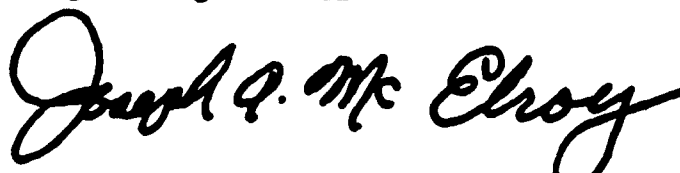
Roger H. Wood
Vice President



This Phase I Inspection Report on Marino Pond Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.


JOSEPH W. PENEGAN, JR., MEMBER
Water Control Branch
Engineering Division


CARNEY H. TERZIAN, MEMBER
Design Branch
Engineering Division


JOSEPH A. MCELROY, CHAIRMAN
Chief, WED Materials Testing Lab.
Foundations & Materials Branch
Engineering Division

APPROVAL RECOMMENDED:


JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm runoff), or a fraction thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
Letter of Transmittal	
Brief Assessment	
Review Board Page	
Preface	i
Table of Contents	ii & iii
Overview Photo	iv
Location Map	v

REPORT

1. PROJECT INFORMATION

1.1 General	
a. Authority	1-1
b. Purpose of Inspection	1-1
1.2 Description of Project	
a. Location	1-2
b. Description of Dam and Appurtenances	1-2
c. Size Classification	1-2
d. Hazard Classification	1-3
e. Ownership	1-3
f. Operator	1-3
g. Purpose of Dam	1-3
h. Design and Construction History	1-3
i. Normal Operational Procedures	1-3
1.3 Pertinent Data	1-4

2. ENGINEERING DATA

2.1 Design	2-1
2.2 Construction	2-1
2.3 Operation	2-1
2.4 Evaluation	2-1

3. VISUAL INSPECTION

3.1 Findings	
a. General	3-1
b. Dam	3-1
c. Appurtenant Structures	3-2
d. Reservoir Area	3-2
e. Downstream Channel	3-2
3.2 Evaluation	3-3

4. OPERATIONAL PROCEDURES

4.1 Procedures	4-1
4.2 Maintenance of Dam	4-1
4.3 Maintenance of Operating Facilities	4-1
4.4 Description of any Warning System in Effect	4-1
4.5 Evaluation	4-1

TABLE OF CONTENTS (Cont'd)

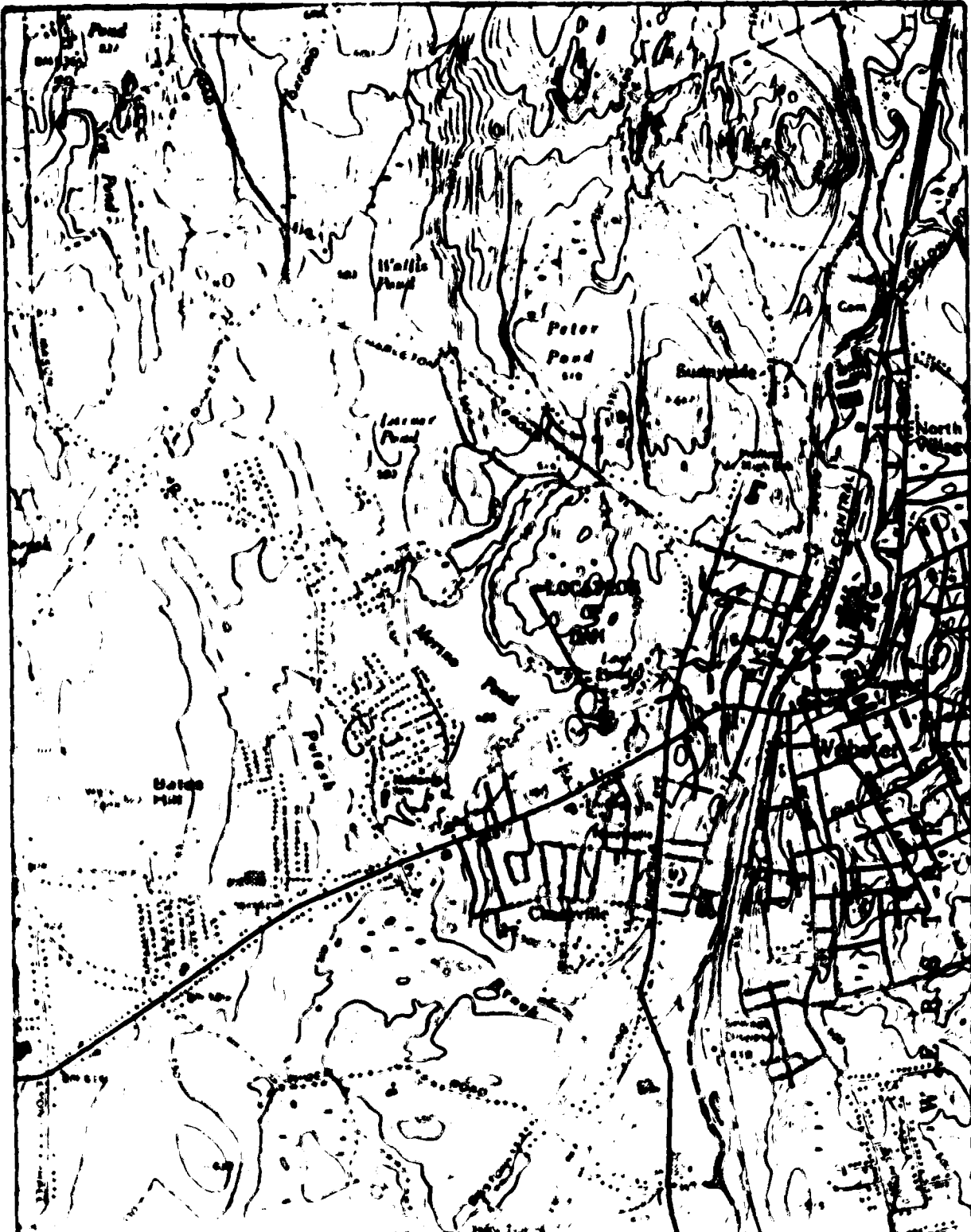
	<u>Page</u>
5. HYDRAULIC/HYDROLOGIC	
5.1 Evaluation of Features	5-1
a. General	5-1
b. Design Data	5-1
c. Experience Data	5-1
d. Visual Observations	5-1
e. Test Flood Analysis	5-1
f. Dam Failure Analysis	5-1
6. STRUCTURAL STABILITY	
6.1 Evaluation of Structural Stability	6-1
a. Visual Observation	6-1
b. Design and Construction Data	6-1
c. Operating Records	6-1
d. Post-Construction Changes	6-1
e. Seismic Stability	6-1
7. ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES	
7.1 Dam Assessment	7-1
a. Condition	7-1
b. Adequacy of Information	7-1
c. Urgency	7-1
d. Need for Additional Investigation	7-1
7.2 Recommendations	7-1
7.3 Remedial Measures	7-2
a. Operation and Maintenance Procedures	7-2
7.4 Alternatives	7-2
 <u>APPENDIXES</u>	
APPENDIX A - INSPECTION CHECKLIST	A-1
APPENDIX B - ENGINEERING DATA	B-1
APPENDIX C - PHOTOGRAPHS	C-1
APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS	D-1
APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS	E-1



1. OVERVIEW OF DOWNSTREAM FACE OF DAM AND SPILLWAY



2. OVERVIEW OF UPSTREAM FACE OF DAM FROM LEFT ABUTMENT AREA.



DAM MERINO POND DAM

IDENTIFICATION NO. MA 00110



LOCATION MAP
USGS QUADRANGLE

WEBSTER, MASS - CONN.

APPROX. SCALE: 1" = 2000'

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

MERINO POND DAM
MA 00110

SECTION 1: PROJECT INFORMATION

1.1 General

- a. Authority - Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region.

Camp Dresser & McKee Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Camp Dresser & McKee Inc. under a letter of 27 March 1979, from Colonel John P. Chandler, Corps of Engineers. Contract No. DACW 33-79-C-0053 has been assigned by the Corps of Engineers for this work. Haley and Aldrich, Inc. has been retained by Camp Dresser & McKee Inc. for the soils and geological portions of the work.

- b. Purpose - The primary purpose of the investigation is to:

- (1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.
- (2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.
- (3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

- a. Location - Merino Pond Dam is located at the southeast end of Merino Pond, separating it from Low Pond in the Town of Dudley, Massachusetts, as shown on the report's Location Map. Discharge from the dam flows to the French River, a distance of approximately 2,000 feet downstream. The coordinates for the dam are 71 degrees- 53.6 minutes longitude and 42 degrees- 03.0 minutes latitude.
- b. Description of Dam and Appurtenances - Merino Pond Dam consists of a retained earth embankment with a paved spillway across the crest. An abandoned outlet pipe extends through the embankment to a mill building along the right embankment of the dam. A sketch plan of the dam and appurtenances is included in Appendix C-1.

The dam has an overall length of about 285 ft. and a maximum height of about 19.5 ft. The portion of the embankment located to the left of the spillway is formed by near vertical stone retaining walls upstream and downstream. The crest elevation at the upstream face is about 3 ft. higher than at the downstream face.

The dam embankment to the right of the spillway and adjacent to the mill widens, becomes nearly level and grades into natural ground in the right abutment area. The foundation wall of the mill building retains the right end of the abutment on the downstream side.

The 30 ft. wide spillway, located near the center of the dam, consists of a concrete slab invert and stone masonry training walls, which taper from 5.3 feet high at the upstream end, to a 3.3 ft. height at the downstream end. Six metal supports are present on the crest of the spillway about 5.5 ft. in from the upstream face of the dam. The supports provide for 7 bays of flashboards having a maximum height of 3.5 ft. A 4 ft. wide walkway spans the spillway above the flashboards. Approximately 20 ft. beyond the left abutment of the dam is a depressed area about 20 ft. wide with an invert elevation 2.8 ft. lower than the top of the dam. This depressed area would act as an emergency overflow during major flooding events.

The outlet works for the dam have been abandoned and there is presently no means of dewatering the pond. A 3 ft. by 8.5 ft. rectangular concrete wet well is located on the dam crest about 60 ft. to the right of the spillway. The intake to the well consists of a box conduit of unknown dimensions having an intake invert approximately 9.5 ft. below the top of dam and a wooden trash rack on the upstream face. Water is withdrawn from the well via a 10-in. C.I. pipe by a pump located within the mill.

- c. Size Classification - The maximum height of the dam is approximately 19.5 feet and the estimated total storage capacity at the

top of the dam is 762 acre-feet. According to guidelines established by the Corps of Engineers, the dam is classified in the small category based on both storage capacity and height.

- d. Hazard Classification - The results of the Merino Pond Dam Failure analysis indicate that Low Pond dam will be overtopped and affect several homes by high velocity sheet flow. The Stevens Linen mill would be affected as well as several other houses and commercial structures in that densely developed area before the dam failure outflow discharges to the French River. The potential loss of life would be more than a few persons. Consequently, the dam is classified in the "high" hazard category.
- e. Ownership - The dam is owned by Stevens Linen Associates. The owner is represented by Mr. Robert Javery, Plant Engineer, Stevens Associates, Box 220, Webster, MA 01570 (Phone: 617/943-0600).
- f. Operator - Mr. Robert Javery is assigned responsibility for operation of the dam.
- g. Purpose of the Dam - Merino Pond Dam provides for water storage and provides process water for the down-cream mills. In addition, it is used for recreation by adjacent residents. At one time, Merino Pond was used to generate power at the dam site. However, the associated electrical equipment is now abandoned.
- h. Design and Construction History - The date of the actual construction of the dam is unknown. There are no plans, specifications or computations available from the Owner, County, or State offices concerning the design or construction of the dam. Due to the type of construction utilized, it is estimated that the dam was constructed prior to 1900. A review of prior State and County inspection reports dating back to January 1925 together with correspondence records and a Proposed Plan of Repairs dated June 23, 1932, indicate that repair work has been performed on the dam. In a letter dated 12 December 1931 the County recommended that a reinforced concrete core wall, one foot higher than the existing stone wall, be poured against the upstream wall; that the walkway spanning the spillway be raised 18 inches; that self-releasing flashboards be employed; and that the embankment be raised to the new height of core wall. A plan titled "Proposed Repairs to Dam" dated June 1932 proposes that the upstream stone wall be taken down and relaid in cement mortar to an elevation 1 foot higher than the existing stone wall. The plan also calls for widening the spillway by 10 feet and to extend the bridge and flashboards across the proposed 30 ft. wide spillway. A letter from the County dated 7 Feb. 1933 indicates that repairs were made. An October 1938 County inspection report indicates that spillway repairs were made in 1937 and an October 1963 inspection report states that "the

flood gate is inoperable. This gate was leaking so the owners piled up gravel in front of the gate." No records were found pertaining to the installation of a wet well within the crest of the dam.

- i. Normal Operating Procedure - There is no established procedure for the operation of the dam. The condition of the dam and spillway indicate little maintenance is performed on a routine basis. The normal level of the flashboards is based on the needs of both the Owner and adjacent home owners. Flashboards are reportedly removed in anticipation of high run-off.

- 1.3 Pertinent Data - There are no known elevations previously established at the dam site. Consequently, the water surface elevation of 485 shown on the USGS Quadrangle, Webster, MA-COMM., 1969, was adopted as spillway crest elevation. All other elevations given in this report pertaining to the dam site were estimated from the assumed spillway crest elevation.

- a. Drainage Area - The drainage area tributary to the dam is approximately 4.4 square miles of flat terrain at about 1 percent slope. Approximately 9 percent of the watershed is ponded water with additional small marshy areas. There is considerable storage potential upstream of Merino Pond. Pierpont Meadow Pond, located at the northern edge of the watershed, at one time drained naturally to both the Merino Pond and the Buffumville Reservoir watersheds. Now, an earthen dam has been constructed along the southern edge of Pierpont Meadow Pond, causing it to drain strictly to Buffumville Reservoir. There is scattered development throughout the Merino Pond drainage area with dense development along the western and southern banks of Merino Pond.

- b. Discharge at Dam Site - There are no records of discharges at the dam site.

- (1) Outlet works:.....None
- (2) Maximum known flood at damsite.....Unknown
- (3) Ungated spillway capacity at top of dam:
1,050 cfs @ 490.3 elev. (The swale to the north of the dam has an estimated additional capacity of 250 cfs)
- (4) Ungated spillway capacity at test flood elevation:
1,300 cfs @ 491.1 elev.
- (5) Gated spillway capacity at normal pool elevation: N/A
- (6) Gated spillway capacity at test flood elevation: N/A

(7) Total spillway capacity at test flood elevation:
1,300 cfs @ 491.1 elev.

(8) Total Project discharge at test flood elevation:
2,000 cfs @ 491.1 elev.

c. Elevation (ft. above NGVD)

(1) Streambed at centerline of dam.....470.8
(2) Test flood tailwater.....475.0
(3) Upstream portal invert diversion tunnel.....N/A
(4) Normal pool.....485.0
(5) Full flood control pool.....N/A
(6) Spillway crest.....485.0
(7) Design surcharge (Original Design).....Unknown
(8) Top of dam..... 490.3 (Nominal)
(9) Test flood surcharge.....491.1

d. Reservoir

(1) Length of test flood pool.....0.6 miles
(2) Length of normal pool.....0.6 miles
(3) Length of flood control pool.....N/A

e. Storage (acre-feet)

(1) Normal pool.....305
(2) Flood control pool.....N/A
(3) Spillway crest pool.....305
(4) Top of dam.....762
(5) Test flood pool.....850

f. Reservoir Surface (acres)

(1) Normal pool.....76
(2) Flood-control pool.....N/A
(3) Spillway Crest.....76

(4) Test flood pool.....101

(5) Top of dam.....98

g. Dam Embankment

(1) Type.....Retained earth embankment

(2) Length.....Approx. 285 ft

(3) Height.....Approx. 19.5 ft

(4) Top width and Elevation.....Approx. 25 ft
at elev. 490.3

(5) Side slopes.....Vertical stone retaining
walls U/S and D/S

(6) Zoning..... Unknown

(7) Impervious Core..... Unknown

(8) Cutoff..... Unknown

(9) Grout Curtain.....Probably None

h. Diversion and Regulating TunnelNone

i. Spillway

(1) Type..... 30 ft. wide by 5 ft. high rectangular
channel with provisions for 3.5 ft. of
flashboards

(2) Length of weir.....30 ft

(3) Crest elevation.....485

(4) Gates.....None

(5) U/S Channel.....Merino Pond

(6) D/S Channel.....Low Pond

j. Regulating Outlets - There are no regulating outlets at this
dam.

SECTION 2: ENGINEERING DATA

- 2.1 Design Records - No design records were located for the original dam at Merino Pond. Design data in the form of a plan for modifications to the dam crest and spillway dated June 1932 was located and is included in Appendix B.
- 2.2 Construction Records - No records of the original construction or modifications were located.
- 2.3 Operation Records - No operation records other than inspection reports on the facility were located.
- 2.4 Evaluation
 - a. Availability - Documents described above are included in Appendix B.
 - b. Validity - There are no known design, construction or operating records. The drawings of modifications to the dam crest and spillway were in good agreement with conditions observed during the site examination.
 - c. Adequacy - The absence of known records of the original design and construction requires that the evaluation of the dam during this investigation be based primarily on the visual examination described in the following section and the modification drawing.

SECTION 3: VISUAL INSPECTION

3.1 Findings

- a. General - The Phase I visual examination of Merino Pond Dam was conducted on 13 August 1979.

In general, the facility was observed to be in poor condition. This classification is primarily based on observed seepage in the area of the spillway and apparent lateral movement of the left downstream masonry wall. The reservoir level at the time of the site examination was 2.0 feet above the spillway crest.

Visual inspection checklists for the site visit are included in Appendix A and selected photographs are given in Appendix C.

- b. Dam - Merino Pond Dam, shown in Photos 1 and 2, is in generally poor condition. The dam is basically an earth fill dam retained by stone masonry walls with a spillway located approximately at the center of the dam crest. Apparent lateral movement and some seepage were noted at the downstream retaining wall, and local depressions were observed at the dam crest. The following specific items were noted:

- (1) Apparent lateral movement and possible settlement was observed at the left downstream retaining wall which may have been the cause of some dislodged stones also noted at this location. (See Photo 7)
- (2) Seepage was observed at the downstream face at two locations:
 - (a) There was active seepage with rust staining at the toe of the downstream retaining wall to the right of the spillway. (See Photo 8)
 - (b) Seepage was noted just below the spillway apron at the downstream retaining wall as shown in Photo 5. Directly beneath this seepage exit, as shown in Photo 6, an accumulation of light brown coarse sand and small gravel was noted at the bottom of the spillway which suggests that some embankment fill has washed through the retaining wall. Active movement of soil particles was not evident.
- (3) There was brush growing from the downstream retaining wall and the spillway training walls. A heavy growth of brush and trees was observed at the base of the downstream retaining wall.
- (4) The crest was covered with grass and weeds as shown in Photo 3. Depressions in the crest were noted behind and all along the left spillway training wall and behind the

upstream retaining wall, to the right of the spillway. No evidence of movement was noticed at these locations.

- (5) There was an accumulation of debris observed at the bottom of the abandoned outlet located at the downstream retaining wall to the right of the spillway cascade.
- (6) Two cracks were observed in the spillway concrete apron. One crack intersects a 12 in. by 3 in. hole (indicated in Photo 4) in the slab. The spillway training walls have mortar missing from the joints at the upstream ends of the walls adjacent to the flashboards.

c. Appurtenant Structures

- (1) Outlet Works - The outlet works appeared to consist of an upstream inlet which opened to a metal conduit which, in turn, discharged into a channel beneath the linen mill building located at the dam right abutment. The outlet works was observed to be abandoned and inoperative. There was no evidence of any other means of dewatering the pond.
 - (2) Footbridge - A footbridge spans the spillway at the upstream side of the dam crest, as shown in Photo 4, and is seated on the spillway training walls. The bridge consisted of two 12 in. deep steel channels which support a wood plank deck and metal pipe handrails. The downstream handrail was noted to be slightly loose. Minor rusting of the channels and the handrails and minor spalling of the left training wall bridge seat were observed.
 - (3) Wet Well - The wet well located to the right of the spillway on the dam crest, and the well inlet, which draws directly from the pond, were observed to be in generally good condition. The wooden trash rack at the well inlet, shown in Photo 10, has started to deteriorate.
- d. Reservoir Area - While there is extensive development along the western and southern banks of the reservoir, the eastern bank of the pond has practically no development. Larner Pond is located about 400 feet upstream of Merino Pond. Side slopes to the pond are generally flat. No significant potential for landslides into the pond which would create waves that might overtop the dam were observed during the site examination. No conditions were noted which could result in a sudden increase in sediment load into the pond.

- e. Downstream Channel - Merino Pond discharges through a rectangular spillway to Low Pond whose pool is 14 feet lower than the spillway crest of Merino Pond Dam. Low Pond discharges to a natural channel which runs through a masonry stone arch culvert and through the Steven's Linen Mill complex located about 700 feet downstream of Merino Pond Dam. The stone arch culvert upstream of the mill complex is small (about 35 square feet) and controls discharge through the mill complex so long as the water surface upstream of the culvert is at or below roadway elevation (about 19'± above the invert of the culvert).

The channel through the mill complex is winding and of variable geometry. It runs through the mill complex for about 200 feet before entering a 200 foot long concrete arch culvert, which discharges to the French River.

- 3.2 Evaluation - In view of the apparently satisfactory performance of the dam at present, the observed evidence of seepage and movement of the downstream stone masonry retaining wall are not considered cause for immediate concern. However, changes in the pattern or amount of seepage, or further movement of the wall could indicate the development of problems with the retained earth embankment. Furthermore, the absence of a means by which the pond can be dewatered is a condition that should be attended to.

SECTION 4: OPERATIONAL PROCEDURES

- 4.1 Procedures - In general, there is no formally established routine for the operation of the dam.
- 4.2 Maintenance of the Dam - The dam and spillway receive minimal maintenance. There is no established formal procedure for the maintenance of the dam.
- 4.3 Maintenance of Operating Facilities - Water is withdrawn from the pond as needed by the downstream mill by the process water pump through a 10-inch C.I. pipe. Maintenance of the outlet is performed on the basis of need.
- 4.4 Description of Any Warning System in Effect - There is no established warning system or emergency preparedness plan in effect for this structure.
- 4.5 Evaluation - Maintenance of the facility is being performed on the basis of need. There is currently no formal operational procedures in effect for Merino Pond Dam. Formal operational procedures, maintenance programs, warning system and emergency preparedness plans should be established.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

- a. General - Merino Pond Dam is approximately 285 feet long with the spillway located near the center of the dam. A depressed area at the left abutment of the dam acts as an emergency overflow. The pond has a surface area of 76 acres and a storage capacity of 305 acre-feet at spillway crest elevation (485 National Geodetic Vertical Datum). Merino Pond Dam is basically a high surcharge low spillage project during minor flooding events. The 4.4 square mile area draining to Merino Pond is flat (about 1 percent slope) and about 9 percent ponded water which tends to attenuate major flooding events.
- b. Design Data - There is no hydraulic/hydrologic design data available for this dam.
- c. Experience Data - No records of past floods are available for this dam. A 1963 County Inspection Report mentions that the pond reportedly rose to within 6-in. of the top of dam during the 1955 flood.
- d. Visual Observations - A visual inspection of the dam and reservoir area was made on 13 August 1979. At that time, there were 3 feet of flashboards in the spillway with provisions for a maximum of 3.5 feet. There was no flow through the spillway. The water surface elevation was about 1 foot below the top of flashboards (W.S. El. 487.0 NGVD). A 4-foot wide walkway spans the spillway crest.
- e. Test Flood Analysis - Based on the Corps of Engineers Guidelines, the recommended test flood range for the size, small, and hazard potential, high, is $\frac{1}{2}$ PMF (Probable Maximum Flood). The $\frac{1}{2}$ PMF was adopted as the test flood for this project, as the dam is towards the lower portion of the size classification range. The magnitude of the test flood was determined using the Corps of Engineers Guidelines for Phase I Dam Safety Investigations. Based on the flat tributary drainage area of which 9 percent is ponded water, a $\frac{1}{2}$ PMF inflow of 600 cfs per square mile was selected for the 4.4 square mile drainage area. The resulting peak test flood inflow for the project is approximately 2,650 cfs.

Surcharge storage routing of the test flood inflow under the condition of no flashboards resulted in a routed test flood outflow of 2,000 cfs at a stage of 491.1 feet. The spillway capacity at top of dam is 1,050 cfs while the swale to the north of the dam has a capacity of approximately 250 cfs under the same conditions. The total discharge capabilities at the top of the dam is, therefore, 65 percent of the routed test flood outflow. The routed test flood outflow would overtop the dam by about 0.8 feet.

- f. Dam Failure Analysis - Based on Corps of Engineers Guidelines for Estimating Dam Failure Hydrographs, and assuming that a failure would occur along 40 percent of the mid-height length (150 ft) of the dam with water surface at the top of dam (elev. 490.3), the peak failure outflow would be approximately 8,700 cfs. As a result of a dam failure, a densely populated section of the Town of Dudley, located in the vicinity of the Stevens Linen Mill Complex, would be affected. Most of the dam failure impact area would experience low depth - high velocity sheet flow, although some areas in the vicinity of the natural channel would be impacted by high depth flooding. Several homes, industrial and commercial buildings, and roads, including State Routes 12 and 197 as well as the Stevens Linen Mill Complex would be affected. In addition, the dam at Low Pond would be overtopped by greater than 2 feet, causing possible damage to the dam. Accordingly, Merino Pond Dam is classified as having a "high" hazard potential.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

- a. Visual Observations - The left downstream stone retaining wall shows evidence of displacement. Evidence of seepage was noted at the face and toe of the downstream retaining walls. These conditions are considered indicative of the need for repairs, although urgent remedial action is not necessary. It is expected that the safety factor with respect to the stability of the downstream retaining wall may be less than conventional limits.
- b. Design and Construction Data - The drawing obtained from the County of Worcester, Massachusetts shows the basic plan and elevation view of the dam. However, there is no information concerning the lateral dimensions of the stone retaining walls and no data on the engineering properties of the fill material in the dam, nor how it was placed. In absence of this data and in view of the apparent displacement of the downstream wall, a theoretical analysis of the structural stability of the dam is not possible. Furthermore, it cannot be assumed that the safety factor for static stability resulting from such an analysis is greater than the minimum acceptable value of safety recommended by the Guidelines.
- c. Operating Records - No operating records other than inspection reports by the State and County were located.
- d. Post-Construction Changes - Modification to the crest of the dam, the upstream face, and the spillway are recommended in available documents dated 1931. The visual examination of the facility indicated that, in general, the proposed modifications to the crest and spillway were accomplished. Further documentation indicates that the upstream stone wall was also modified in 1933, although not in the manner suggested in the 1931 recommendations.
- e. Seismic Stability - Merino Pond Dam is located along the boundary of a Seismic Zone No. 1 and 2. It cannot be assumed that the dam would be stable under seismic loading due to the condition of the downstream face even though it is a low risk area. Since pertinent data needed for a theoretical analysis of seismic stability is not available, the seismic stability of the dam is unknown.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

- a. Condition - Based on the results of the visual examination, the dam embankment is considered to be in poor condition. Although some repairs are needed, no conditions which would warrant urgent remedial action were noted.
- b. Adequacy of Information - The evaluation of the dam embankment has been based primarily on the visual examination, consideration of available records and past performance and application of engineering judgment. Generally, the information available or obtained was adequate for the purposes of the Phase I assessment. However, it is recommended that additional information relative to embankment stability be obtained as outlined in Section 7.2.
- c. Urgency - The recommendations for additional investigations and remedial measures, outlined in Sections 7.2 and 7.3 respectively, should be undertaken and completed by the Owner within one year after receipt of this report by the Owner.
- d. Need for Additional Investigations - Additional investigations should be performed by the Owner as outlined in Section 7.2.

7.2 Recommendations

It is recommended that the Owner arrange for the following investigations to be undertaken by a registered professional engineer:

1. Evaluate the long-term stability of the embankment, including consideration of seepage conditions at the spillway and the right embankment, engineering properties of embankment materials, the seismic stability of the embankment and the need for repair or modification of the downstream stone retaining wall. Consideration should be given to the potential for and the effects of changes in seepage conditions and further lateral displacement of the downstream retaining wall.
2. A detailed hydrologic-hydraulic investigation to determine the need and means of increasing the discharge capacity at the dam. The investigation should also consider the need and means of providing erosion protection at the emergency overflow swale if the use of this swale is to be continued.
3. An investigation to determine the required repairs, modifications or new construction necessary to provide a method of lowering the reservoir water surface in times of emergency.

The Owner should implement corrective measures as required, based on the above engineering evaluations.

7.3 Remedial Measures

- a. Operation and Maintenance Procedures - The following remedial work should be undertaken by the Owner:
1. Reshape the crest to fill depressions and provide a uniform crest elevation. The crest should be mowed regularly to permit visual examination.
 2. Cut and remove brush and weeds from the spillway discharge channel. Also remove brush, trees, weeds, and debris from and within 20 ft. of the downstream retaining wall.
 3. The spillway flashboards should be removed and not be reinstalled pending the results of the investigation stated in 7.2.2.
 4. Repair cracks and patch the hole in the spillway apron concrete.
 5. Reset displaced stones in the downstream retaining wall.
 6. Repair joints in the spillway retaining walls.
 7. Perform maintenance on the footbridge spanning the spillway in the form of repainting the exterior of the structure, tightening the downstream handrail, and repainting the left bridge seat.
 8. Develop a formal maintenance program and operational procedure. The maintenance program should provide for the visual monitoring of seepage conditions and lateral displacement of the downstream retaining wall until an engineering evaluation such as the one recommended in 7.2-1 can be completed and acted upon.
 9. Develop a formal emergency procedures plan and warning system in cooperation with local officials and institute a program of annual technical inspections.

7.4 Alternatives - There are no practical alternatives recommended.

APPENDIX A
INSPECTION TEAM ORGANIZATION AND CHECK LIST

Page No.

VISUAL INSPECTION PARTY ORGANIZATION

A-1

VISUAL INSPECTION CHECK LIST

Embankment

A-2

Spillway

A-3

Spillway (con't)

A-4

Outlet Works

A-5

Special Structure: Well located at Dam Crest

A-6

Special Structure: Footbridge

A-7

VISUAL INSPECTION PARTY ORGANIZATION

NATIONAL DAM INSPECTION PROGRAM

DAM: Merino Pond Dam

DATE: 13 August 1979

TIME: 9:00 AM

WEATHER: Overcast - Temperature 55 - 60⁰ Northeasterly winds; say
15 mph

WATER SURFACE ELEVATION UPSTREAM: 2.0' \pm above spillway El.

STREAM FLOW: Zero

INSPECTION PARTY:

1. Joseph E. Downing - CDM - Hydrology/Hydraulic
2. Francis E. Luttazi - CDM - Operations/Structural
3. John Critchfield - Haley & Aldrich
4. Douglas Gifford - Haley & Aldrich
5. _____

PROJECT FEATURE

INSPECTED BY

REMARKS

1. _____
2. _____
3. _____
4. _____

PRESENT DURING INSPECTION:

1. _____
2. _____
3. _____

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Merino Pond Dam

DATE: 13 August 1979

EMBANKMENT: _____

BY: JWC & DGG

CHECK LIST	CONDITION
<p>1. Upstream Slope</p> <p>a. Vegetation</p> <p>b. Sloughing or Erosion</p> <p>c. Rock Slope Protection - Riprap Failures</p> <p>d. Animal Burrows</p> <p>2. Crest</p> <p>a. Vegetation</p> <p>b. Sloughing or Erosion</p> <p>c. Surface cracks</p> <p>d. Movement or Settlement</p> <p>3. Downstream Slope</p> <p>a. Vegetation</p> <p>b. Sloughing or Erosion</p> <p>c. Surface cracks</p> <p>d. Animal Burrows</p> <p>e. Movement or Cracking near toe</p> <p>f. Unusual Embankment or Downstream Seepage</p> <p>g. Piping or Boils</p> <p>h. Foundation Drainage Features</p> <p>i. Toe Drains</p> <p>4. General</p> <p>a. Lateral Movement</p> <p>b. Vertical Alignment</p> <p>c. Horizontal Alignment</p> <p>d. Condition at Abutments and at Structures</p> <p>e. Indications of Movement of Structural Items</p> <p>f. Trespassing</p> <p>g. Instrumentation Systems</p>	<p>1.</p> <p>a. None (masonry retaining wall)</p> <p>b. None observed.</p> <p>c. Not applicable.</p> <p>d. None observed.</p> <p>2.</p> <p>a. Grass & weeds.</p> <p>b. Depressions noted behind U/S wall on right side and behind left spillway training wall.</p> <p>c. None observed.</p> <p>d. None apparent.</p> <p>3.</p> <p>a. Some brush growing from masonry retaining wall.</p> <p>b. None observed.</p> <p>c. None observed.</p> <p>d. None observed.</p> <p>e. See 4a.</p> <p>f. Wall wet and dripping at several locations. Concentrated seepage exiting at base of wall, right of spillway (est. 15-25gpm). Seepage water is clear. Iron staining noted.</p> <p>g. Accumulation of coarse sand along base of wall, below spillway. Could be material washed thru, stones, but no active soil movement observed. No boils noted.</p> <p>h. None known.</p> <p>i. None known.</p> <p>4.</p> <p>a. Apparent bulging of D/S retaining wall on left side. Some stones dislodged.</p> <p>b. Good.</p> <p>c. Looks OK, except D/S bulging of wall.</p> <p>d. U/S wall at rt. abutment is 1.5 ft. higher than at spillway.</p> <p>e. Wall bulge as noted above.</p> <p>f. Restricted by high wire fence.</p> <p>g. None known.</p>

**VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM**

DAM: Merino Pond Dam

DATE: 13 August 1979

SPILLWAY: _____

BY: F.E.L.

CHECK LIST	CONDITION
1. Approach Channel a. General Condition b. Obstructions c. Log Boom etc.	Note: Spillway fronts on pond. 1. a. Good. b. None observed. c. None observed.
2. Weir a. Flashboards b. Weir Elev. Control (Gate) c. Vegetation d. Seepage or Efflorescence e. Rust or Stains f. Cracks g. Condition of Joints h. Spalls, Voids Or Erosion i. Visible Reinforcement j. General Struct. Condition	2. a. Wood flashboards are in good condition. Steel flashboard supports are in good condition. b. None observed. c. None observed. d. Minor seepage observed through flashboard joints at all flashboard sections. e. None observed. f. None observed. g. N/A. Flashboarding founded directly on spillway apron. h. N/A i. N/A j. Good.
3. Discharge Channel a. Apron b. Stilling Basin c. Channel Floor d. Vegetation e. Seepage f. Obstructions g. General Struct. Condition	3. a. N/A. Apron is not substantially differentiated from channel floor. b. None observed. c. Two cracks were observed in spillway apron. One crack is located at the upstream end of spillway, just downstream of the flashboards, and extends the width of the spillway parallel to the downstream face. The second crack extends the length of the spillway perpendicular to the downstream face and is located to the right of spillway center line. d. Minor shrub growth observed to left of channel downstream at base of training wall. e. Seepage noted beneath channel floor. f. See 3d. g. Fair.
4. Walls a. Wall Location _____ (1) Vegetation (2) Seepage or Efflorescence (3) Rust or Stains (4) Cracks (5) Condition of Joints (6) Spalls, Voids or Erosion (7) Visible Reinforcement (8) General Struct. Condition	

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Merino Pond Dam

DATE: 13 August 1979

SPILLWAY: (Continued)

BY: F.E.L.

CHECK LIST	CONDITION
1. Approach Channel <ul style="list-style-type: none"> a. General Condition b. Obstructions c. Log Boom etc. 	4. <ul style="list-style-type: none"> a. Left Spillway Training Wall <ul style="list-style-type: none"> 1. Vine and brush growth observed. 2. Minor seepage observed immediately adjacent to flashboards. 3. None observed. 4. None observed. 5. Fair. Mortar missing from joints at upstream. 6. None noted. 7. N/A. Stone masonry construction. 8. Good. b. Right Spillway Training Wall <ul style="list-style-type: none"> 1. Minor brush growth. 2. Minor seepage observed immediately adjacent to flashboards. 3. None observed. 4. None observed. 5. Fair. Mortar missing from joints at upstream. 6. None observed. 7. N/A. Stone masonry construction. 8. Good.
2. Weir <ul style="list-style-type: none"> a. Flashboards b. Weir Elev. Control (Gate) c. Vegetation d. Seepage or Efflorescence e. Rust or Stains f. Cracks g. Condition of Joints h. Spalls, Voids Or Erosion i. Visible Reinforcement j. General Struct. Condition 	
3. Discharge Channel <ul style="list-style-type: none"> a. Apron b. Stilling Basin c. Channel Floor d. Vegetation e. Seepage f. Obstructions g. General Struct. Condition 	
4. Walls <ul style="list-style-type: none"> a. Wall Location _____ <ul style="list-style-type: none"> (1) Vegetation (2) Seepage or Efflorescence (3) Rust or Stains (4) Cracks (5) Condition of Joints (6) Spalls, Voids or Erosion (7) Visible Reinforcement (8) General Struct. Condition 	

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Merino Pond Dam

DATE 13 August 1979

OUTLET WORKS: Abandoned.

BY: F.E.L.

CHECK LIST	CONDITION
1. Inlet <ul style="list-style-type: none"> a. Obstructions b. Channel c. Structure d. Screens e. Stop Logs f. Gates 	<p>Note: Outlet works consist of conduit which draws from an inlet at the upstream dam face, and empties into a discharge channel located beneath the mill works. The works are abandoned and inoperable. There is no gate mechanism at the inlet gate.</p>
2. Control Facility <ul style="list-style-type: none"> a. Structure b. Screens c. Stop Logs d. Gates e. Conduit f. Seepage or Leaks 	<ul style="list-style-type: none"> 1. <ul style="list-style-type: none"> a. None observed. b. N/A. Inlet draws directly from pond. c. Mortared stone gate structure in good general structural condition. d. Rust and corrosion evident. Several bars severed. e. None observed. f. Submerged.
3. Outlet <ul style="list-style-type: none"> a. Structure b. Erosion or Cavitation c. Obstructions d. Seepage or Leaks 	<ul style="list-style-type: none"> 2. <ul style="list-style-type: none"> a. N/A. Abandoned.
4. Mechanical and Electrical <ul style="list-style-type: none"> a. Crane Hoist b. Hydraulic System c. Service Power d. Emergency Power e. Lighting f. Lightning Protection 	<ul style="list-style-type: none"> 3. <ul style="list-style-type: none"> a. Conduit extends from inlet to wood bulkhead at head of discharge channel. There is a 12" Ø blank flanged conduit extending from wooden bulkhead. b. Not observable. c. Outlet discharge channel beneath millworks substantially obstructed by abandoned machinery, wood debris, and rubble. d. Seepage through joints of bulkhead planking. Seepage beneath upstream side of left outlet discharge training wall.
5. Other	<ul style="list-style-type: none"> 4. N/A. Abandoned.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Merino Pond Dam

DATE: 13 August 1979

SPECIAL STRUCTURE: Well located at Dam Crest

BY: F.E.L.

CHECK LIST	CONDITION
Well	There is a concrete walled well located at the center of the dam crest to the right of the spillway. Well plan dimensions are approximately 3 ft. by 8½ ft. The well is enclosed by a wood bulkhead. General structural condition of the well is good.
Well Inlet	The well inlet fronts directly on the pond and is submerged. A wood bar screen is located at the well inlet and is in fair condition. Evidence of wood deterioration was observed and one broken slat noted. Further investigation prohibited by inlet submergence.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Merino Pond Dam

DATE: 13 August 1979

SPECIAL STRUCTURE: Footbridge

BY: F.E.L.

CHECK LIST	CONDITION
Footbridge	<p>Note: There is a structural steel footbridge spanning the spillway at the upstream end directly over the flashboarding. Two, 12 in. deep steel channels support a wood plank deck and metal handrails. The bridge consists of one span and is seated approx. 9 in. into spillway training walls. Steel channels and metal handrails exhibit minor rusting. Downstream handrail is of threaded pipe connection type and slightly loose. Bridge seat at left has spalled. With the exception of the loose downstream handrail, the footbridge is in good general structural condition.</p>

APPENDIX B

LIST OF AVAILABLE DOCUMENTS AND
PRIOR INSPECTION REPORTS

DOCUMENTS

List of Available Documents

Page No.

B-1

PRIOR INSPECTION REPORTS

Date

By

Page No.

	Worcester County (Index)	B-2
January 7, 1925	Worcester County	B-3
1925	Worcester County (Letter)	B-4
March 24, 1930	Worcester County	B-5
December 12, 1931	Worcester County (Letter)	B-6
January 4, 1931	Worcester County (Computations)	B-7
January 27, 1932	Worcester County	B-8
February 27, 1932	Worcester County (Notes)	B-9
February 7, 1933	Worcester County (Letter)	B-10
January 13, 1937	Worcester County	B-11
October 19, 1938	Worcester County	B-12
December 30, 1941	Worcester County	B-13
November 10, 1942	Worcester County	B-14
February 18, 1944	Worcester County	B-15
December 11, 1945	Worcester County	B-16
December 1, 1947	Worcester County	B-17
December 2, 1950	Worcester County	B-18
November 29, 1951	Worcester County	B-19
September 13, 1955	Worcester County	B-20
September 25, 1963	Worcester County	B-21
March 5, 1969	Worcester County	B-22
March 21, 1969	Worcester County	B-23
September 9, 1969	Worcester County	B-24
January 18, 1972	Mass. Div. of Waterway	B-25

DRAWINGS

No.

Title

Page No.

Proposed Repairs to Dam
at Stevens Linen Co.
Dudley, MA
July 5, 1932

B-26

LIST OF DOCUMENTS

MERINO FOND DAM

All available documents are included in Appendix B

APPENDIX B-1

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by L. O. Marden Date Jan. 7, 1925 Dam No. 14-07

Town Dudley Location Near Webster Merino Pond
Owner Stevens Linen Works Use Mill Pond and Storage
Material and Type Earth vert. up and downstream walls

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY LENGTH 21'

El. top Abutment 100. El. Crest 95.5 El. Apron _____ El. Streambed 86.

Width top Abutment 30. Width top Crest 30. Width bottom Spillway 36-40

Width Flashboards carried 3.7 Kind Flashboards wood

El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____

Kind of Foundation under Spillway Gravel - Rock Soil

Condition good.

EMBANKMENT LENGTH 220.' Main dam is actually 60' long.

El. Top 100. El. Natural Ground _____ Width Top 30.

Width of Bottom 36. Upstream Slope vert. wall Downstream Slope vert. walls.

Kind of Corewall none visible Riprap _____

Material in Embankment earth Foundation gravel-rock soil

Condition grown up with brush and trees.

GATES waste gate filled up Location 25' south of spillway

Size _____ Kind _____ El. Flowline _____

Condition filled up

WHEEL Kind _____ Size _____ Rated H. P. _____

Location _____ Ave. Head _____

Evidence of Leaks in Structure none

Recent Repairs and Date none

Topography of Country below Dam mill pond

Nature of Buildings and Roads below Dam Stevens Linen Works.

Number Acres in Pond _____ Drainage Area in Square Miles _____

Discharge in Sec. 100 ft. per Square Mile _____

Volume of Water in Cubic Feet _____

County of Worcester

OFFICE OF COUNTY ENGINEER

Court House, Worcester, Mass.

L. O. Marden
County Engineer

1925.

Town Dudley

Dam no. 14,07

Stevens Linen Works,
Dudley Mass.

Location near Webster.

The County Commissioners of Worcester County, acting under Chapter 252, General Laws, as amended by Chapter 178 of the Acts of 1924, said section being headed "Safety of Dams and Reservoirs", have ordered an inspection of your dam. The above Acts states in part regarding the inspection of dams,--

"The county commissioners shall at least once in two years cause a thorough examination to be made of every reservoir, reservoir dam and mill dam by the breaking of which loss of life or damage to a road or bridge is likely to be caused,--

The commissioners shall cause every examination to be made by a competent engineer who shall report in detail and the work or the changes required for safety and the public good." The County Commissioners hereby order that the following repairs be made to your dam: (Note: Repairs to be made are marked with a cross.)

1. Repair down stream wall
2. " " " "
3. " " walls to spillway section
4. " " " canal or flume
5. " " concrete walls
6. " " apron to spillway
7. " " Leaks at
8. Renew planks and timbers
9. Clean out waste gate pipe or flume. ☒
10. " " canal to mill
11. Provide new waste pipe or flume
12. " " pipe to mill thru embankment
13. Remove flashboards
14. Lower
15. Construct spillway section spillway to be _____ feet long and _____ feet deep at _____
16. Cut off brush and trees from embankment
17. Fill up holes and regrade embankment

Kindly notify us either in person or by letter after you have made these repairs.

Yours very truly,

P. O. Marden
County Engineer

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L. O. Norden Date 3-24-30 Dam No. 14-07

Town Dudley Location _____

Owner Stevens Linen Works Use _____

Material and Type _____

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY—Length _____ Feet Depth _____ Feet

El. top Abutment _____ El. Crest _____ El. Apron _____ El. Streambed _____

Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____

Width Flashboards carried _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____

Kind of Foundation under Spillway _____

Condition flashboards too high—close to underside of platform joists.

EMBANKMENT—Length overall _____ Feet

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Bottom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition recommend top upstream stone wall be concreted—large open joint should be filled—downstream wall is lower than upstream wall by 3'—should have embankment raised and regraded—grub out roots.

GATES _____ Location _____

Size _____ Kind _____ El. Flowline _____

Condition _____

WHEEL _____ Kind _____ Size _____ Rated H. P. _____

Location _____ Ave. Head _____

Evidence of Leaks in Structure good sized stream from north end dam—north embankment has several leaks underneath it.

Recent Repairs and Date _____

Topography of Country below Dam _____

Nature of Buildings and Roads below Dam _____

Number of Acres in Pond _____ Drainage Area in Square Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage in Cubic Feet _____

Dec. 14, 1931.

Stevens Linen Works,
Dudley, Mass.,
Attention Mr. Crawford:-

Dear Sir:-

An inspection was recently made, as you know, in company with you, of your dam, our number 14-07, at Upper Terino Pond, at Dudley, Mass., according to state law, and we found that the following repairs should be made:

1. Large stones and boulders, now on top of embankment, should be placed at downstream foot embankment.
2. A reinforced concrete corewall, at least one foot higher than the present upstream stone wall, should be poured against the present wall, so that all holes in wall be filled with concrete. The top of this wall should be 12 inches wide. The floor and sidewalls of the spillway should also be lined with concrete.
3. The walkway across the spillway should be raised at least 18 inches.
4. Flashboards should be held in position by iron pins that could bend and remove flashboards automatically, at times of highwater, so that human aid would not have to be relied upon.
5. Embankment should be raised, so that its top would be even with new elevation of concrete walls.
6. I consider that this dam is in poor condition, as water is seeping out of downstream face of spillway, and that these repairs should be made immediately.

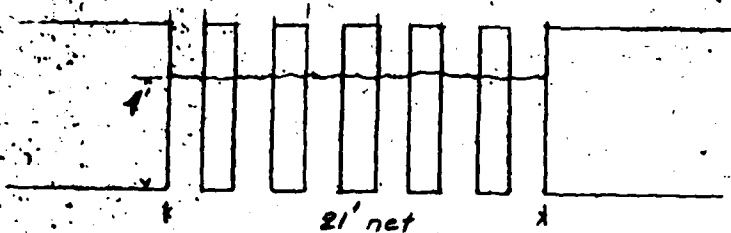
yours very truly,

Charles H. Houghton

14-07

Jan. 4, 1931

K.M.F.



$$q = 3.33 (b - 1.2h) h^{3/2}$$

$$q = 3.33 (21 - 1.2 \times 4 \frac{1}{2})$$

$$= 3.33 \times 16.2 \times 8$$

$$= 431.56 \text{ cfs} \quad \text{say } 430 \text{ cfs}$$

MERINO

Assumed 60 cfs/sq. mi. max flood SUDBURY

$$60 \times 4.9 = 294 \text{ cfs.}$$

RIVER MAX 44.2 cfs/1/4

Assumed 75 cfs/sq. mi. max flow

$$75 \times 4.9 = 367.5 \text{ cfs.}$$

The above figures do not take into consideration the dams on Mayden, Larned, and Peter Ponds

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoirs, and Reservoirs.
Prof. C.M. Allen-Worc. Poly. Institute-

Inspected by L.O. Morden

Date Jan. 27, 1932. Dam No. 14-07

Town Dudley Location Upper Merino Pond .
Owner Use
Material and Type

Dam Designed by Constructed by Year

SPILLWAY—Length Feet Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Prof. Allen agrees that bridge should be raised 2 feet, and that concrete wall should be built on upstream side of spillway.

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Mile

Discharge in Second feet per Square Mile

Estimated Storage in Cubic Feet

Dusley

14-07

Report by Capt. A/C. Feb 27 1934 in file 10-34. Chapter

(dam should be raised 10" - face front side with concrete)

14-07
Feb. 7, 1933.

Stevens Liner Works,
Dulley, Mass.,
Attention Mr. Cranford,
Dear Sir:

I wish to inform you, that I recently inspected the
work done by your company, on Upper Merino Pond, in Dulley,
according to State Law. It was indeed a pleasure to view
structure, that has been rebuilt, in such a substantial
manner.

Yours very truly,

County Engineer

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L. O. M. Master Mech. Healey Date 1-18-37 Dam No. 14-07

Town Dudley Location Upper Merino or High Pond

Owner Stevens Ligno Works Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY—Length Feet. Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition OK Water spouting thru each abutment wall in small stream --not dangerous. Should be stopped.

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Hiprap

Material in Embankment Foundation

Condition OK

GATES Location

Size Kind El. Flowline

Condition OK

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure see above

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Foot per Square Mile

Estimated Storage Capacity in Cubic Feet

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by ES Giner Date Oct 19-1938 Dam No. 14-07

Town Dudley Location Upper Merino

Owner Stevens Lumber Use Bar

SPILLWAY 20'-0" long

El. top Abutment 5'-0" Cast El. Crest El. Apron El. St. Bed 11'-0"

Width top Abut. Width top Crest Width bottom Sp. way 35'

Width flashboards 2 1/2 x 4'-0" Kind Flashboards Wood

El. Flowline Cleanout Pipe Size and Kind Pipe

Kind of Foundation under Spillway

Condition OK 1937 Repaired

Small leaks on Both Abut. of Spillway

EMBANKMENT

El. Top 5'-0" Cast El. Natural Ground Width Top 25'

Width of Bottom Upstream Slope Plumb Downstream Slope

Kind of Corewall None Riprap None

Material in Embankment Gravel faced with masonry

Condition OK

GATES

Size 4'-0" x 4'-0" Kind Wood Location

El. Flowline 11'-3"

Condition OK

Evidence of Leaks in Structure

Recent Repairs and Date Painted in 1935

Number Acres in Pond Drainage Area in Sq. Miles

Discharge in Second Feet per Square Mile

Estimated Million Cubic Feet

H. W. 3" above top flashboards
3 1/2" of flashboards above crest

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by _____ Date 12-30-41 Dam No. 14-07

Town Dudley Location Upper Merumo Pond

Owner _____ Use _____

SPILLWAY
El. top Abutment _____ El. Crest _____ El. Apron _____ El. St. Bed _____
Width top Abut. _____ Width top Crest _____ Width bottom Sp. way _____
Width flashboards _____ Kind flashboards _____
El. Flowline Cleanout Pipe _____ Size and Kind Pipe _____
Kind of foundation under Spillway _____
Condition OK

EMBANKMENT
El. Top _____ El. Natural Ground _____ Width Top _____
Width of Bottom _____ Upstream Slope _____ Downstream Slope _____
Kind of Corewall _____ Riprap _____
Material in Embankment _____ Foundation _____
Condition OK

GATES _____ Location _____
Size _____ Kind _____ El. Flowline _____
Condition OK

Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Number Acres in Pond _____ Drainage Area in Sq. Miles _____
Discharge in Second Feet per Square Mile _____
Capacity in Million Cubic Feet _____

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by John A. H. H. H. Date 11-10-92 Dam No. 14-07

Town Dudley Location Morris Pond

Owner Stevens Mill Assoc. Use _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. St. Bed _____

Width top Abut. _____ Width top Crest _____ Width bottom Sp. way _____

Width flashboards 2 1/2 ft. Kind Flashboards Wood

El. Flowline Cleanout Pipe _____ Size and Kind Pipe _____

Kind of Foundation under Spillway _____

Condition Small leaks at both abutments of spillway

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Bottom _____ Upstream Slope _____ Downstream Slope _____

Kind of Core wall _____ Riprap _____

Material in Embankment Gravel and Caped Earth Foundation _____

Condition Apparently OK

GATES

Location Center

Size 2 pipes to walls Kind _____ El. Flowline _____

Condition Good

Evidence of Leaks in Structure None

Recent Repairs and Date 10 yr ago

Number Acres in Pond _____ Drainage Area in Sq. Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

**COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER**

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by J. A. Nichols Date 7-18-42 Dam No. 12-27

Town Dudley Location _____
Owner _____ Use _____
Material and Type _____

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. Streambed _____
Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____
Width Flashboards carried 6 ft Kind Flashboards _____
El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____
Kind of Foundation under Spillway _____
Condition Good

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____
Width of Bottom _____ Upstream Slope _____ Downstream Slope _____
Kind of Corewall _____ Riprap _____
Material in Embankment _____ Foundation _____
Condition Good

GATES

Location _____
Size _____ Kind _____ El. Flowline _____
Condition Needs New Trash rack, old one rusted, many bars rusted thru

WHEEL _____ Kind _____ Size _____ Rated H. P. _____
Location _____ Ave. Head _____
Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Topography of Country below Dam _____

Nature of Buildings and Roads below Dam _____

Number Acres in Pond _____ Drainage Area in Square Miles _____

Discharge in Second Foot per Square Mile _____

Estimated Storage Million Cubic Feet _____

COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by R. M. F. - Haly Date 12-11-45 Dam No. 16-57

Town Tisbury Location Milline Pond
Owner Stevens Pond Use _____
Material and Type _____

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY
El. top Abutment _____ El. Crest _____ El. Apron _____ El. Streambed _____
Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____
Width Flashboards carried _____ Kind Flashboards _____
El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____
Kind of Foundation under Spillway _____
Condition ok

EMBANKMENT
El. Top _____ El. Natural Ground _____ Width Top _____
Width of Bottom _____ Upstream Slope _____ Downstream Slope _____
Kind of Corewall _____ Riprap _____
Material in Embankment _____ Foundation _____
Condition ok

GATES Location _____
Size _____ Kind _____ El. Flowline _____
Condition Soft mechanism needs minor repairs

WHEEL Kind Horizontal Size 24" Rated H. P. 50
Location _____ Ave. Head 5-8 ft
Evidence of Leaks in Structure _____

Recent Repairs and Date _____
Topography of Country below Dam _____
Nature of Buildings and Roads below Dam _____

Number Acres in Pond _____ Distance Area in Square Miles _____
Discharge in Second Feet per Square Mile _____
Estimated Storage Million Cubic Feet _____

TOWN Dudley

DAM NO. 14-07

LOCATION Upper Merino Pond

STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS
DAM INSPECTION REPORT

OWNED BY Stevens Line Associates PLACE Dudley USE Industrial

INSPECTED BY E.V. Meagher-L.O.M DATE Dec. 1, 1947

TYPE OF DAM high earth embankment-downstream CONDITION fair to good
battered wall- concrete lined spillway

SPILLWAY

FLASHBOARDS IN PLACE yes RECENT REPAIRS none

CONDITION small leaks under each abutment

REPAIRS NEEDED cutoff leaks

EMBANKMENT

RECENT REPAIRS none

CONDITION good

REPAIRS NEEDED none

GATES

RECENT REPAIRS none

CONDITION gate stem removed-to install new gate

REPAIRS NEEDED to install new gate

LEAKS

HOW SERIOUS some seepage same as previous inspection

DATE Dec. 1, 1947

S. O. Meagher
ENGINEER

TOWN Dudley

DAM NO. 14-07

LOCATION Upper Merino Pond

STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Steven L. Linn Associates PLACE Dudley USE Storage

INSPECTED BY LOM DATE Dec. 2, 1950

TYPE OF DAM High Earth Emb - stone wall CONDITION Fair to Good

SPILLWAY

FLASHBOARDS IN PLACE None RECENT REPAIRS None

CONDITION fair

REPAIRS NEEDED Enlarge spillway.

EMBANKMENT

RECENT REPAIRS None

CONDITION sec. under leaks

REPAIRS NEEDED _____

GATES

RECENT REPAIRS None

CONDITION appear good

REPAIRS NEEDED _____

LEAKS

HOW SERIOUS small
Good size leaks under emb at gate section. Also seepage
at ~~gate~~ ^{abutment}

DATE Dec. 2, 1950

J. O. Hinkle
COUNTY ENGINEER

TOWN DudleyDAM NO. 13-17

LOCATION _____

STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Stevens Linen Co

PLACE _____

USE WaterINSPECTED BY W. H. [unclear]DATE 11/29/51

TYPE OF DAM _____

CONDITION _____

SPILLWAYFLASHBOARDS IN PLACE 4 ft - RemovableRECENT REPAIRS NoneCONDITION GoodREPAIRS NEEDED NoneEMBANKMENTRECENT REPAIRS NoneCONDITION GoodREPAIRS NEEDED NoneDATESRECENT REPAIRS NoneCONDITION GoodREPAIRS NEEDED NoneLEAKSSmall leak under Conc. Apron - No Hazard

HOW SERIOUS _____

DATE _____

COUNTY ENGINEER _____

TOWN

Dudley

DAM NO.

14-07

LOCATION

STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS
DAM INSPECTION REPORT

OWNED BY

PLACE

USE

INSPECTED BY

LHS & LHS,

DATE

Sept. 13, 1955

TYPE OF DAM

CONDITION

SPILLWAY

FLASHBOARDS IN PLACE

RECENT REPAIRS

CONDITION

OK

REPAIRS NEEDED

*3 1/2' of flashboards
now in place*EMBANKMENT

RECENT REPAIRS

CONDITION

OK

REPAIRS NEEDED

GATES

RECENT REPAIRS

CONDITION

operation questionable

REPAIRS NEEDED

LEAKS

HOW SERIOUS

DATE

CITY ENGINEER

TOWN Dudley DAM NO. 14-07
LOCATION "Marino Village" STREAM Larner Brook

"Upper Marino Pond"
WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by Sevens Linen Associates Place Dudley Use Mill Pond
Inspected by W. J. - McCreedy Date Oct. 25, 1969
Type of Dam Earth, Stone and Gravity Condition Fair

SPILLWAY

Flashboards in Place 20" of boards Recent Repairs _____
Condition Good condition - This spillway has 3 dykes with concrete
Repairs Needed boards. The roadway in front of the present water level
is above the spillway crest.

EMBANKMENT

Recent Repairs The brush has recently been cut
Condition McCreedy says that the water came within
Repairs Needed 4" of the top of the dam in the 1965 flood.

GATES

Recent Repairs The flood gate is inoperative. This gate was
Condition broken to the concrete. A gravel is located at the
Repairs Needed gate. The gate & the mill is good.

LEAKS

How Serious No leaks are visible.

DATE: _____ County Engineer

TOWN Dorchester DAM NO. 14-07
LOCATION Merrimack STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by Place Use
Inspected by E. P. Quinn Date 5 MAR 69
Type of Dam Condition

SPILLWAY

Flashboards in Place Recent Repairs
Condition clear, flash boards 3' high
Repairs Needed water level over top of boards

EMBANKMENT

Recent Repairs
Condition
Repairs Needed

GATES

Recent Repairs
Condition closed
Repairs Needed

LEAKS

How Serious
DATE: County Engineer

TOWN DundeeDAM NO. 14-07 Marion Pond

LOCATION _____

STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTSD A M I N S P E C T I O N R E P O R T

Owned by _____

Place _____

Use _____

Inspected by Raymond

Date _____

Type of Dam _____

Condition _____

SPILLWAYFlashboards in Place yesRecent Repairs 7 gateways 3 withflashboardsCondition Water level is 24 ins above crestRepairs Needed gates closedEMBANKMENT

Recent Repairs _____

Condition _____

Repairs Needed _____

Recheck 3-21-69Water level 2' above crest
4 gates partially open
3 gates closedGATES

Recent Repairs _____

Condition _____

Repairs Needed _____

3/21/69

TOWN Dudley DAM NO. 14-07 - Maine Village

LOCATION _____ STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by _____ Place _____ Use _____

Inspected by B. Dwyer Date 9 Oct 69

Type of Dam _____ Condition _____

SPILLWAY

Flashboards in Place 15' boards Recent Repairs _____

Condition Good - level 2' above crest

Repairs Needed _____

EMBANKMENT

Recent Repairs _____

Condition _____

Repairs Needed _____

GATES

Recent Repairs _____

Condition _____

Repairs Needed _____

LEAKS

How Serious _____

DATE: 9 Sept 1969 B. Dwyer

County Engineer

INSPECTION REPORT & DATA FOR DAMS

Owner: STEVENS LINEN ASSOCIATES
 His Address: MILL ST DUDLEY
 Function of Dam: MILL POND

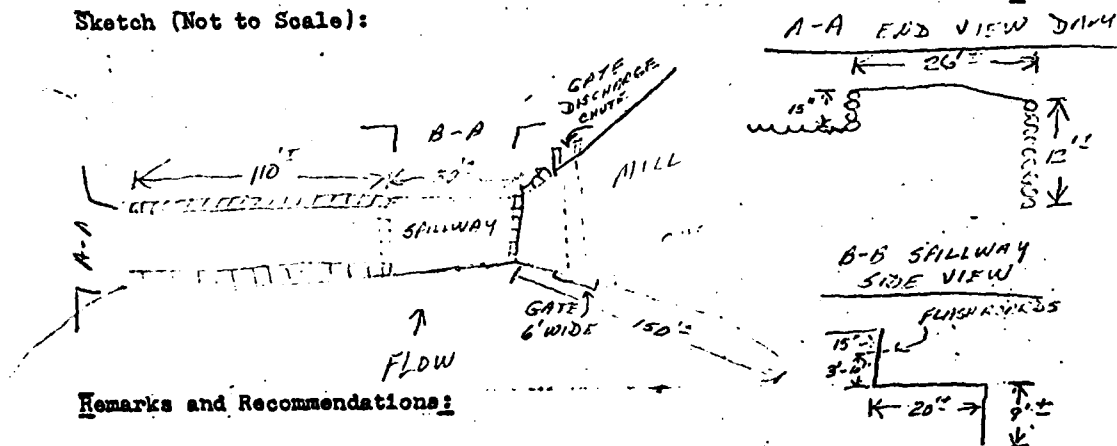
Location & Access: North of Chaseville &
 West of Rte. 12
 USGS Quad. Webster Lat. 42°02'53" Long. 71°53'40"
 Drain. Ar.: 4.40 Sq. Mi.; Ponds: ao.; Res. @ Dam: 83.09
 Character of D.A.:

(M)
 Dam No. 14-07
 Town: DUDLEY
 Stream: Brook
 Pond: MARINO POND
 Date: 1/10/72
 By:
 CONDITION RATING
 Structural: GOOD
 Hydraulic: 5'X30'
 General: GOOD
 PRIORITY: NONE

Estimated
 Discharge:
 Capacity:

General Description of Dam and Discharge Control: EARTH - DRY WALLS
 6' GATE 25' SOUTH OF SPILLWAY FEEDING MILL. NOT IN USE
 AS DISCHARGE CHUTE LOADED W/ DEBRIS AND DRY
 FLASHBOARDS 2"X8"X4' IN GOOD SHAPE

Sketch (Not to Scale):



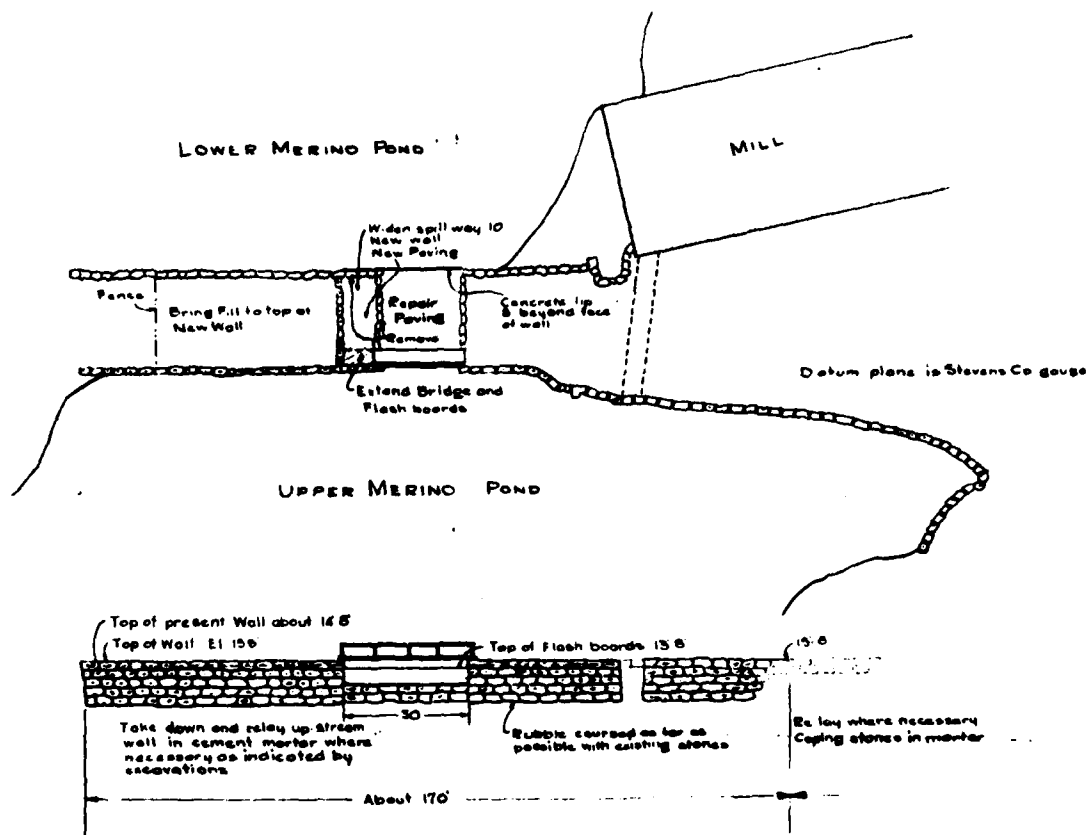
Remarks and Recommendations:

Date
 1/10/72

By VFP
 RST

Comment

Dam No. 14-07



**PROPOSED REPAIRS TO DAM
STEVENS LINEN CO
DUDLEY, MASS.**

JUNE 22 '32 Scale 1"=20'
THE LOWELL-WHIPPLE CO.

COPIED FROM ORIGINAL.

**WORCESTER COUNTY COMMISSIONERS
WORCESTER COUNTY ENGINEERING DEPARTMENT
PLAN OF
PROPOSED REPAIRS
TO DAM
AT STEVENS LINEN CO.
DUDLEY MASS.
AS FILED AND APPROVED BY THE
COUNTY COMMISSIONERS
JULY 5, 1932**

SCALE 1"=20'

Approved: <i>July 5th 1932</i> <i>Charles A. Spade</i> Chairman, Board of County Commissioners	Submitted for Approval: <i>July 24, 1932</i> <i>P. O. Wadsworth</i> County Engineer
<i>Henry H. Whipple</i> County Commissioner	Read By: <i>John C. Felt</i> Date: <i>Sept. 1937</i> CHS-LWS
<i>Elmer M. Bingham</i> County Commissioner	DAM NO. 14-

ATTEST: A TRUE COPY BY

CLERK.

APPENDIX C

SELECTED PHOTOGRAPHS OF PROJECT

LOCATION PLAN

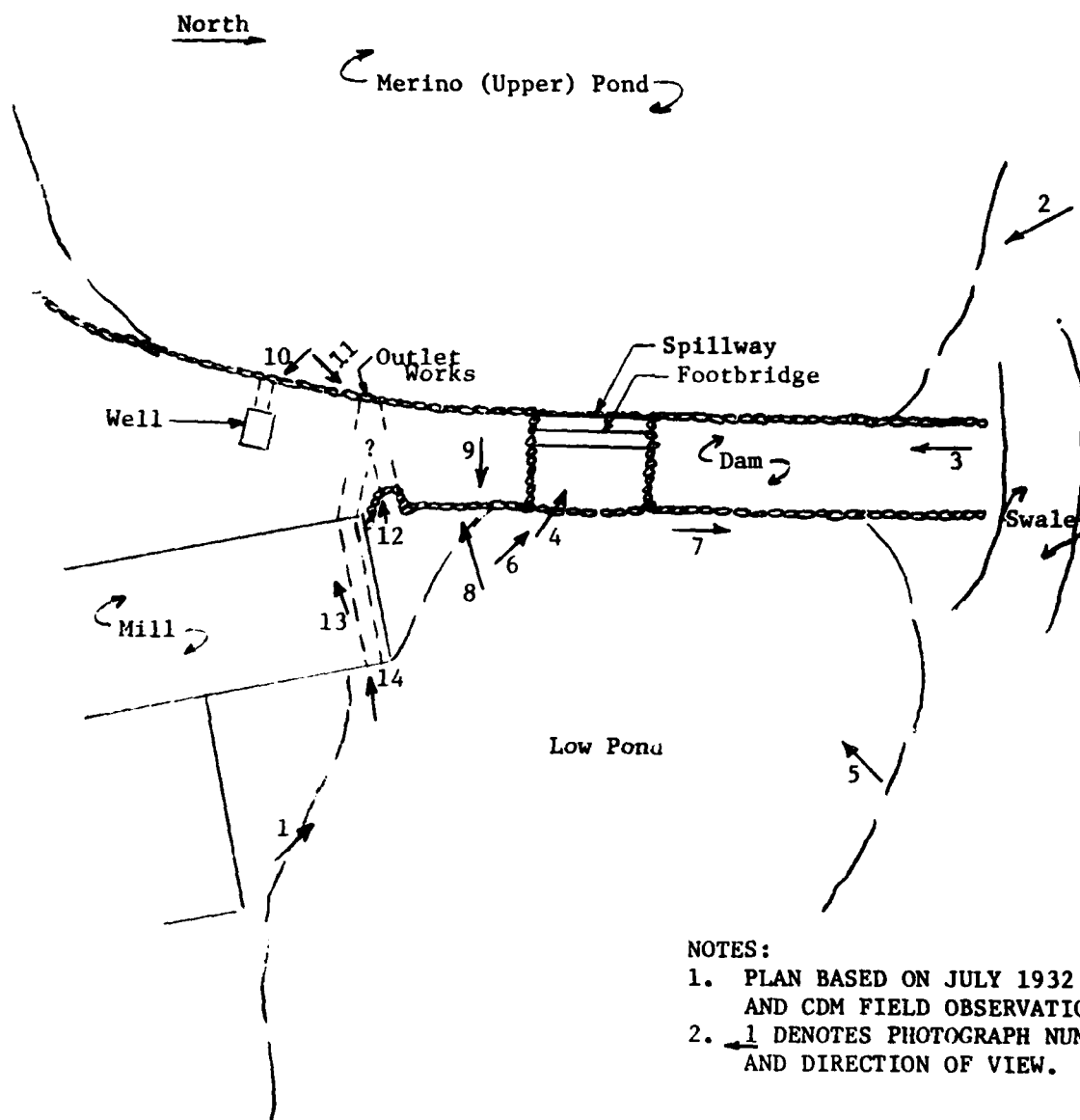
Location of Photographs

Page No.

C-1

PHOTOGRAPHS

<u>No.</u>	<u>Title</u>	<u>Page No.</u>
1.	Overview of Downstream Face of Dam and Spillway	iv
2.	Overview of Upstream Face of Dam from Left Abutment Area	iv
3.	Crest of Dam from Left Abutment	C-2
4.	View of Spillway Showing Bridge, Flashboards and Supports	C-2
5.	Downstream Face and Toe of Spillway	C-3
6.	Sand and Gravel Deposits at Toe of Spillway	C-3
7.	Portion of Downstream Face of Dam Located to the Left of the Spillway	C-4
8.	Seepage Near Toe of Downstream Face of Dam to the right of the Spillway	C-4
9.	View of Downstream Channel from Crest of Dam	C-5
10.	Wooden Trash Rack on Upstream Face of Dam for Intake to Process Water Wet Well	C-5
11.	Trash Rack and Gate Stem at Intake for Abandoned Outlet Works	C-6
12.	Wingwalls and Remains of Wooden Gates on Downstream Face of Dam at Abandoned Outlet Works	C-6
13.	Abandoned Hydro-Power Equipment Beneath Mill Building	C-7
14.	Abandoned Outlet from Beneath Mill Building	C-7



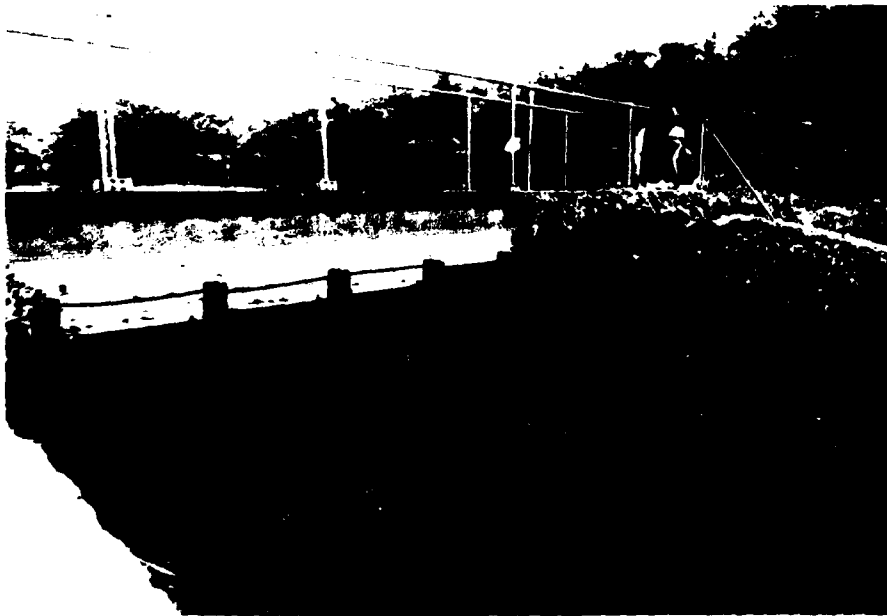
NOTES:

1. PLAN BASED ON JULY 1932 DRAWING AND CDM FIELD OBSERVATIONS.
2. 1 DENOTES PHOTOGRAPH NUMBER AND DIRECTION OF VIEW.

CAMP DRESSER & MCKEE, INC. BOSTON, MASSACHUSETTS		U.S. ARMY ENG. DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA.	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
LOCATION OF PHOTOGRAPHS			
MERINO POND DAM		DUDLEY, MASSACHUSETTS	
		Scale: Not To Scale	
		Date: Sept. 1979	



3. CREST OF DAM FROM LEFT ABUTMENT.



4. VIEW OF SPILLWAY SHOWING BRIDGE, FLASHBOARDS AND SUPPORTS.



5. DOWNSTREAM FACE AND TOE OF SPILLWAY. NOTE FLOW EXITING FROM WALL.



6. SAND AND GRAVEL DEPOSITS AT TOE OF SPILLWAY.



7. PORTION OF DOWNSTREAM FACE OF DAM LOCATED TO THE LEFT OF THE SPILLWAY.



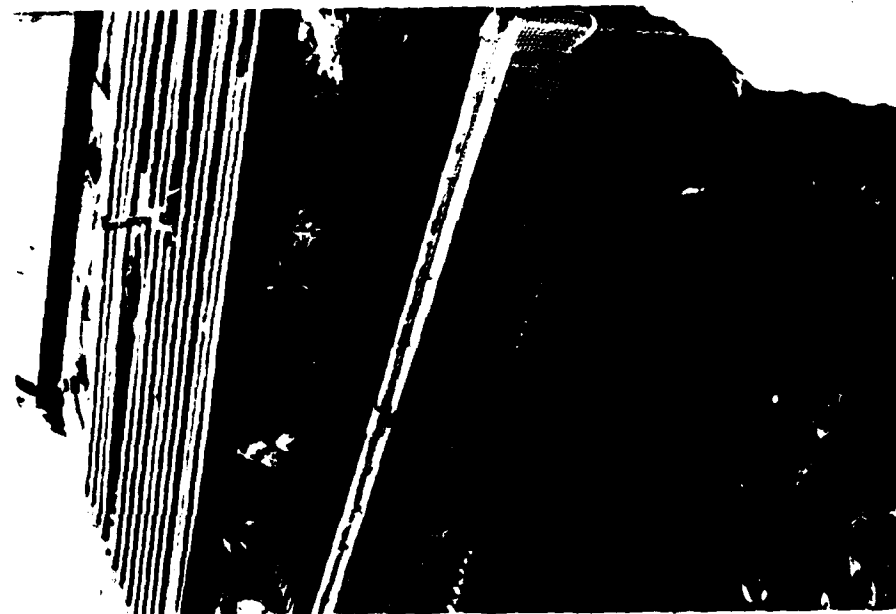
8. SEEPAGE NEAR TOE OF DOWNSTREAM FACE OF DAM TO THE RIGHT OF THE SPILLWAY.



9. VIEW OF DOWNSTREAM CHANNEL (LOW POND) FROM CREST OF DAM.



10. WOODEN TRASH RACK ON UPSTREAM FACE OF DAM FOR INTAKE TO PROCESS WATER WET WELL.



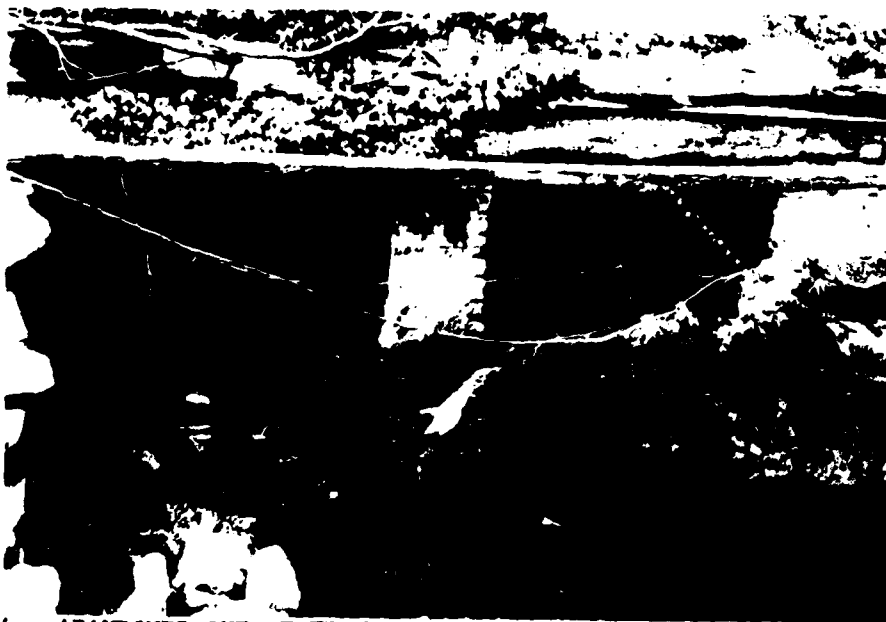
11. TRASH RACK AND GATE STEM AT INTAKE FOR
ABANDONED OUTLET WORKS.



12. WINGWALLS AND REMAINS OF WOODEN GATES
ON DOWNSTREAM FACE OF DAM AT ABANDONED
OUTLET WORKS.



13. ABANDONED HYDRO-POWER EQUIPMENT BENEATH MILL BUILDING.

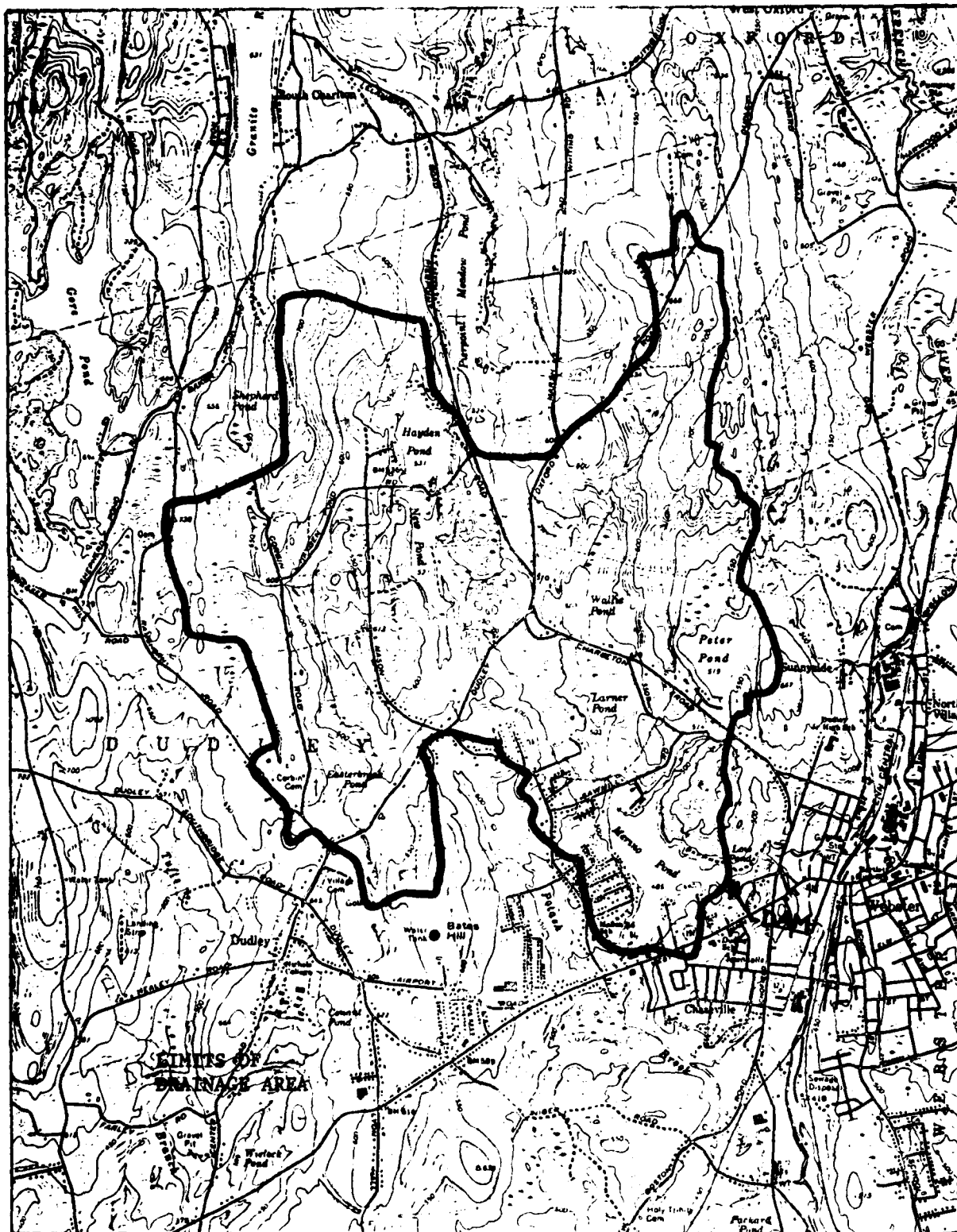


14. ABANDONED OUTLET FROM BENEATH MILL BUILDING.

APPENDIX D

MAPS AND HYDRAULIC/HYDROLOGIC COMPUTATIONS

	<u>Page No.</u>
<u>DRAINAGE AREA MAP</u>	D-1
<u>DAM FAILURE IMPACT AREA MAP</u>	D-2
 <u>COMPUTATIONS</u>	
Elevations; Surface Areas; Storage Volumes; Test Flood Determination	D-3
Stage-Discharge Relationships	D-4
Stage-Discharge and Storage-Elevation Curves	D-5
Surcharge Storage Routing	D-6
Dam Failure Analysis	D-7



DAM MERINO POND DAM

IDENTIFICATION NO. MA 00110

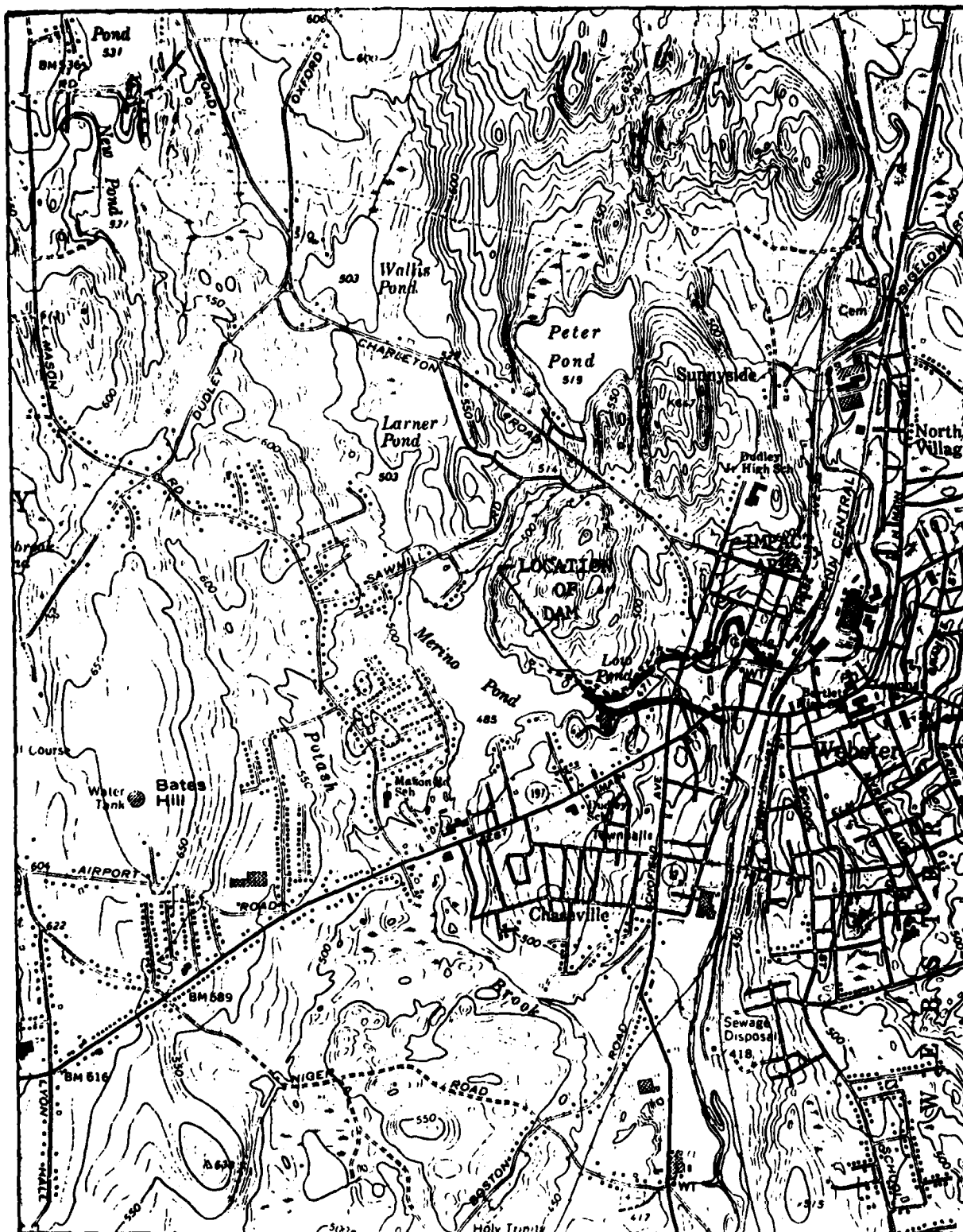


DRAINAGE AREA MAP
USGS QUADRANGLE

WEBSTER, MASS. - CONN.

APPROX. SCALE: 1" = 3150'

APPENDIX D-1



DAM MERINO POND DAM

IDENTIFICATION NO. MA 00110



DAM FAILURE
IMPACT AREA MAP

APPROX. SCALE: 1" = 2000'

APPENDIX D-2

ELEVATIONS

Spillway Crest	485.0 (Based on National Geodetic Vertical Datum)
Crest of Dam	490.3
Toe of Dam	470.8

SURFACE AREAS

Drainage Area 4.40 sq. miles \approx 2816 acres

Total Ponded Water Surface Area \approx 0.4 sq. miles \approx 9% of D.A.

Water Surface Areas at Merino Pond:

- @ elev. 485 (spillway crest) = 76.2 acres
- @ elev. 490 \approx 96.4 acres
- @ elev. 500 \approx 139.6 acres

STORAGE

- @ W.S. El. 485 (Spillway Crest) = $(76.2 \times 12) \frac{1}{3} = 305 \text{ ac-ft}$ ^{assumed avg. dept.}
- @ W.S. El. 490, storage $\approx 305 + \frac{(76.2 + 96.4)}{2} 5 = 736 \text{ ac-ft}$
- @ W.S. El. 500, storage $\approx 736 + \frac{(96.4 + 139.6)}{2} 10 = 1916 \text{ ac-ft}$

TEST FLOOD DETERMINATION

The dam size is "small" based on a height of 19.5 feet and a storage of 762 ac-ft. The hazard is "high" based on the "Dam Failure Analysis" shown on page 5.

Therefore, based on the NED Corps of Engineers Guidelines, the Test Flood range for Merino Pond Dam is:

Test Flood $\approx \frac{1}{2}$ PMF to PMF; use $\frac{1}{2}$ PMF

Given that the DA is 1% ponded water and has a slope of about 1 percent, use a point a quarter the way between the "Flat and Coastal" and "Rolling" curves of the NED Corps of Engineers "Prelim. Guidance for Estimating Max. Probable Discharge in Phase I Dam Safety Investigations" NDRch 1978.

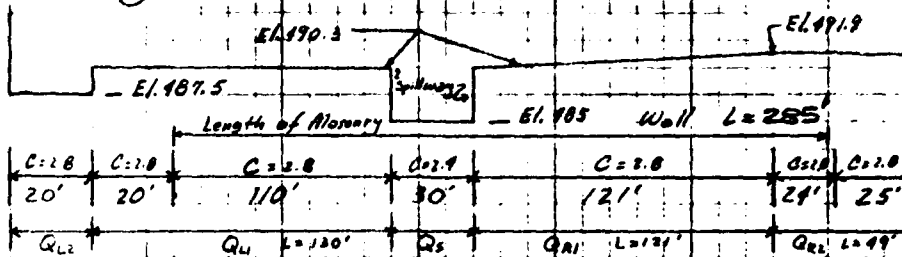
Test Flood Inflow $\approx (1200 \text{ cfs} \times 4.4 \text{ sq miles}) \frac{1}{2} = 2,640 \text{ cfs}$
say 2,650 cfs

STAGE-DISCHARGE RELATIONSHIP

Effective Discharge Weir @ Merino Pond Dam:

assume no flashboards in place. There are facilities for a maximum of 3 1/2 feet of flashboards. At the time of the field inspection (8-13-79), there were 3 feet of flashboards in place at the spillway.

Also assume that walkway over spillway gets washed away during the test.



Stage Discharge Relationship:

U.S. El. (ft)	Q_3 (cfs)	Q_{R1} (cfs)	Q_{R2} (cfs)	Q_{L1} (cfs)	Q_{L2} (cfs)	Total (cfs)
485	—	—	—	—	—	ZERO
486	87	—	—	—	—	87
487	246	—	—	—	—	246
488	452	—	—	—	20	472
489	696	—	—	—	103	799
490	973	—	—	—	221	1,194
491	1,278	30	—	213	367	1,888
492	1,611	289	4	807	535	3,246
493	1,969	887	158	1,615	722	5,351

* No Tailwater effects will influence discharge from Merino Pond. There is a 12' vertical drop to the channel invert.

3-47



SURCHARGE-STORAGE ROUTING

Inflow Test Flood, $Q_p = 2,650$ cfs (see page 1 for Test Flood Determination)

Surcharge Height to pass Q_p is El. 491.60

$$STOR_1 = \frac{\text{Surcharge Storage}}{\text{Drainage Area}} = \frac{605 \text{ ac-ft} \times 12 \text{"/ft}}{2816 \text{ acres}} = 2.578 \text{ inches}$$

$$\text{Probable Maximum Flood, } Q_p = Q_p \left(1 - \frac{STOR_1}{9.5}\right) = 2,650 \left(1 - \frac{2.578}{9.5}\right) = 1,930 \text{ cfs}$$

Surcharge Height to Pass Q_p is El. 491.05

$$STOR_2 = \frac{540 \text{ ac-ft} \times 12 \text{"/ft}}{2816 \text{ acres}} = 2.301 \text{ inches}$$

$$STOR_{AVG} = \frac{2.578 + 2.301}{2} = 2.44 \text{ inches}$$

$$Q_{p_2} = 2,650 \left(1 - \frac{2.44}{9.5}\right) = 1,970 \text{ cfs, say } 2,000 \text{ cfs}$$

Surcharge Height to Pass Q_{p_2} is El. 491.1

\therefore Test Flood Inflow $\approx 2,650$ cfs

Routed Test Flood Outflow $\approx 2,000$ cfs

Surcharge Elevation ≈ 491.1

- Spillway capacity at Test Flood El. (elev 491.1)

$$Q = 2.9(30)(6.1)^{1.5} = 1,310 \text{ cfs, say } 1,300 \text{ cfs}$$

- Spillway capacity at Top of Dam El. (elev 490.3)

$$Q = 2.9(30)(5.3)^{1.5} = 1,060 \text{ cfs, say } 1,050 \text{ cfs}$$

DAM FAILURE ANALYSIS:

Compute Dam Failure Outflow according the NED
Corps of Engineers Guidelines:

$$Q = \frac{8}{127} (g)^{1/2} (W_b) (Y_b)^{3/2}$$

where $g = 32.2 \text{ ft/sec}^2$

W_b = 90 percent of the length
of dam measured from the
left corner of the Mill
Bldg. at the mid-height of
the dam. $\approx 150' \times 0.4 = 60'$

Y_b = Height of dam measured
from crest of dam to toe
of dam. $\approx 19.5'$

then $Q = \frac{8}{127} (32.2)^{1/2} (60') (19.5')^{1.5}$
 $= 8686 \text{ cfs}$ say dam failure outflow $\approx 8,700 \text{ cfs}$

In the event the dam at Merino Pond failed,
the outflow would discharge directly to Lower
Merino pond where some attenuation would occur.

Determine stage at Lower Merino Pond:

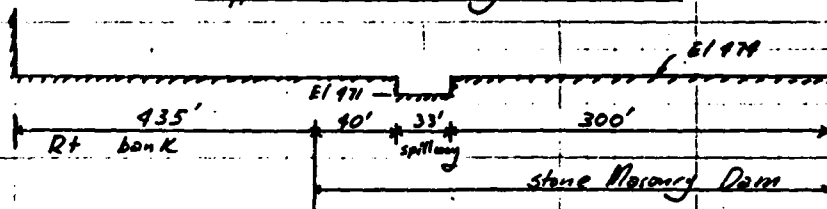
Storage-stage Relationship:

<u>El.</u>	<u>Water Surface Area, acres</u>	<u>Storage Volume, ac-ft</u>
471	3.6	$(3.6 \times 7) \frac{1}{2} = 8.5$
480	7.3	$8.5 + (5.5 \times 9) = 58$

Stage-Discharge Relationship

EI. (ft)	Spillway Discharge (cfs) Let C = 2.9	Overbank Discharge (cfs) Let C = 2.7 for H ≤ 1' C = 2.8 for H > 1'	Total (cfs)
471	0	0	Zero
474	497	0	497
474.5	627	740	1,367
475	766	2,093	2,859
476	1,070	6,138	7,208
477	1,406	11,276	12,682

Effective Discharge Weir



@ Q = 8,700 cfs ; stage = 476.3' ; Storage = 38 ac-ft

flow attenuation : $Q_{out} = Q_{in} \left(1 - \frac{S}{V}\right)$ where S = 38 ac-ft

$$\therefore Q_{out} = 8,700 \text{ cfs} \left(1 - \frac{38}{760}\right) = 8,265 \text{ cfs}$$

V = 760 ac-ft
or storage @
Merino Pond
@ Top of Dam

@ $Q_{out} = 8,300 \text{ cfs}$ Stage = 476.2'

Thus, Lower Merino Pond Dam would be overtopped by 2 feet plus of water, which may cause it to fail.

About $\frac{1}{2}$ the flow would exit by way of the right bank creating high velocity sheet flow of about 2 feet or more depth through a densely developed area all the way to the French River.

The remaining half of the flow (4,000 cfs) would discharge over the spillway and the dam onto the normal brook channel which circles the Steven's Linen Mill before discharging to the French River. Just upstream of the mill complex, the brook runs under a culvert. The capacity of the culvert is approximately 800 cfs with W.S. El. at top of road ($Q = CA V_m = (0.7)(35')^2 (6.2175)$). The remaining 3900+ cfs would overtop the road, dam up against the mill complex and discharge around and through the mill buildings to the French River downstream.

Many commercial, industrial and residential buildings as well as roads and possibly Lower Merino Pond Dam would be affected by a dam failure of Merino Pond creating a "HIGH HAZARD".

APPENDIX E
INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS



INVENTORY OF DAMS IN THE UNITED STATES

STATE	FED ID	UNIFORM NUMBER	STATE	COUNTY	CORNER	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE
MA	027	02	MA	027	02	HERING POND DAM	4203.0	7153.0	24SEP79

POPULAR NAME	NAME OF IMPONDMENT
	HERING POND

RECORD NO.	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01 07	TRIBUTARY TO FRENCH RIVER	DUDLEY	0	7657

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURE MATERIAL	HYDRAULIC MODIFICATION	IMPONDING CAPACITIES (ACRES-FT.)		
REGRPG	1900	S		20	20	762	305

DIST OWN FED R PRV/FED SCS A VER/DATE
NED - N' N : N

REMARKS
22-PRIOR TO

D/S	SPILLWAY	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (ICV)	POWER CAPACITY (KW)	INSTALLED	PACKAGED	NO.	LENGTH	WIDTH	HEIGHT	LENGTH	WIDTH	HEIGHT
1	265	U	30	1050									

OWNER	ENGINEERING BY	CONSTRUCTION BY
STEVENS LINEN ASSOCIATES		

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

INSPECTION BY	INSPECTION DATE	INSPECTION DAY	INSPECTION MONTH	INSPECTION YEAR	AUTHORITY FOR INSPECTION
CAMP DRESSER + MCKEE INC	13AUG79	13	AUG	79	PUBLIC LAW 92-167

REMARKS

END

FILMED

10-84

DTIC